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The following points have also been noted:—On September 12 a thick cluster of points, darker than the bright spot but much brighter than the adjoining dark spot, formed a fringe on the border between Dawes Continent and Dawes Ocean (Proctor's Chart) or Hour-glass Sea, a boundary which, when seen under nearly the same aspect on September 7, had appeared remarkably sharp and distinct. On October 15 the long narrow bright strip stretching into the centre of the disk was very ill-defined at both ends, where it was both fainter and whiter than the rest. A very bright white spot was noted on October 22 on the *s.p.* limb in a position corresponding to the *p.* end of this strip. The large bright patch towards the *s.f.* limb (Lockyer Land of Proctor's Chart) seemed to move round a little more rapidly than the other markings, as if elevated above them. In the course of a couple of hours it seemed to have encroached on the dark strip on its *n.p.* side, making it appear narrower. The bright patch (Lockyer Land) was noted as being very bright and white on October 22. Dawes' so-called "Snow Island" was seen on October 2 as a white spot in De la Rue Ocean.

On August 30 the polar spot appeared to be serrated, showing three indentations round the edge when the definition was at its best. As far as could be judged, this was not an effect of tremor in the air. On September 29 the polar spot was noted as being irregular in shape, and on October 22 the dark ring round it appeared to be much darker on the *f.* side.

The above observations would appear to indicate the presence of occasional clouds in the atmosphere of *Mars*, but they require confirmation.

The outer satellite of *Mars* was seen on five nights and the inner on one, viz. September 28. Only one micrometer measure of the outer satellite was obtained, as follows:—

1877.	G.M.T.	Pos. Angle.	Dist. (from 1st limb).
	h m s	° ′	″
Sept. 29	8 54 56	248 31	67·5

Estimations were made on the other nights.

The observations were made by Mr. Christie and Mr. Maunder.

Royal Observatory, Greenwich,
1877, *November* 9.

Observations of Mars at Madeira, August and September 1877.

By N. E. Green, Esq.

Madeira was chosen as a place of observation for its southern position, its reputation for clear skies during the months of August and September, and because the heat at that season is less than at other places on the same parallel of latitude.

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Observations were commenced on August 19 at a situation to the east of Funchal, having an elevation of 1,200 feet above the sea, and continued till September 14, when a move was made to a position a thousand feet higher, with the hope of improving the definition; but the change was not attended with any decisive advantage.

The great transparency of the atmosphere at Madeira encouraged the expectation of a corresponding degree of sharpness in the telescopic images; but its want of steadiness, arising apparently from conflicting currents of hot and cold air, seriously affected the performance of the instrument, and frequently restricted the amount of amplification that could be employed with advantage. Still there were many good evenings, and amongst them some which merited the term superb.

The following extract from the notes taken on the occasion will enable those interested in the matter to form their own estimate of the value of this situation for astronomical studies. There were altogether 47 nights during which the telescope was ready for work. Out of this number 26 were sufficiently favourable for the use of the pencil, leaving 21 on which no drawings could be made. Of the 26 possible occasions, 10 are entered as good, 4 as excellent, and 2 as grand and superb, the remaining 10 evenings being either passable or poor. They may be tabulated thus:—

Total number of nights	47
Number favourable for drawing	26
Wet, cloudy, or useless	21
	47
Of the 26 favourable nights—	
Entered as good	10
„ excellent	4
Grand and superb	2
Passable or poor	10
	26

Thus out of 47 nights there were 16 of good character, giving a proportion of one-third, a quantity considerably in excess of the average of an English climate. The instrument employed was a 13-inch silver-on-glass reflector, mounted as an altazimuth, its construction being of the most simple character, and so arranged that it could be readily taken to pieces and carried up the steep roads of the island. Its situation was changed four times, and each time it was removed and erected within the day, so that no night was lost.

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The 13-inch mirror was figured by Mr. G. Wills, of Hereford, and most kindly lent by him for the occasion. Its performance either on planet or stars was simply perfect, the higher powers having apparently no effect on its definition. A very fine $12\frac{1}{2}$-inch speculum by Messrs. Horne & Thornthwaite was also employed; and it may be worth the remark to those who are interested in these silver-on-glass mirrors, that the quality of their performance seemed to leave nothing to desire.

The method of mounting may be observed in the photographs which lie on the table. It will be seen that the framework which holds the mirrors in position is open to the external air, excepting at that portion which is nearest the observer; here it is partly closed in order to exclude any currents which might be formed by heat arising from the person. By this open arrangement the tube currents which so generally impair the performance of reflectors are impossible.

A Paper on this subject is in course of preparation, in which the results of the working of a 4-inch achromatic, a 9-inch reflector in the usual iron tube, and a 13-inch speculum mounted in an open frame are carefully registered, showing a most decided advantage in the open arrangement over the usual iron tube.

The drawings, 41 in number, were continued until the whole surface of the planet had passed before the eye, the same phase that had occupied the pencil at an advanced hour of the night on August 19 having returned to the meridian early in the evening of September 19. Drawings were continued till September 29, thus overlapping the series, and producing duplicates of many of the earlier views. Of these views twelve, which were produced on the most favourable occasions, have been carefully copied, and presented for the acceptance of the Society.

Each drawing was made direct from the telescope, and entirely independent of those which had been produced previously; all comparisons being reserved till the evening was over, so that each view might be as free as possible from bias, or a leaning towards the repetition of similar forms. Occasionally the planet was scrutinised most carefully, in order to verify, if possible, the drawings of others, and especially the maps published by Mr. Proctor from the drawings of Mr. Dawes. Attention was also given to the work of M. Terby, and an earnest effort made to answer each query of that painstaking astronomer.

The drawings furnish evidence of the general clearness of the atmosphere of *Mars*, the various details being fairly repeated from night to night, even after the retrograde movement due to the greater length of the Martial day had brought the same phase again to the meridian. The presence of an atmospheric envelope is, however, abundantly shown in the fading both of details and colour towards the limb, and especially from the singular absence of markings towards the north pole, where, in consequence of a lower temperature and shorter exposure to the Sun's rays, a greater amount of condensation would take place.

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In connection with atmospheric effects, a most interesting observation was made on the evening of August 21. On this occasion a series of lines having a meridional direction were seen tending towards the north pole, possibly indicating the flow of currents of cold air to the equator; and on September 29 one of the most firm and definite lines on the planet, the eastern edge of the De la Rue Ocean, was in two places obscured by clouds.

The decrease of the polar zone of snow was most manifest, as in some drawings made in St. John's Wood previous to the voyage to Madeira this zone occupies a space fully twice as great as in those made towards the end of September. A most interesting observation was made on September 1. At 10.40 a brilliant spot of light was seen at a considerable distance from the edge of the snow, on the western portion of the ellipse; this was clearly seen again on the 2nd and 3rd of the month; and on the 8th, during which night the definition was superb, a second point was visible near the first; and again, on September 10, a series of fainter points were figured, forming a line concentric with the zone of snow. These isolated lights were doubtless due to the presence of high ground, which retained its covering of snow after it had disappeared from the lower surfaces. The outline of the zone was also broken up by dark valleys extending into it, and several irregular patches formed projections, which a further contraction might have left as outlying fields of snow.

It has been remarked that these snow caps do not agree exactly with the poles of the axis of revolution. It may be a confirmation of this statement to mention that by September 18, the zone, only a week after it had appeared so large and distinct, was considerably reduced in size and its outline very indefinite, whereas by the end of the month it had returned in great measure to its previous form and size; the rapidity and extent of this change being greater than could be attributed to simple alterations of temperature.

The portions of the planet's surface where the details observed seem least to agree with the drawings made during previous oppositions is that to the east of the De la Rue Ocean. Here are figured in Mr. Proctor's maps, and in the drawings of some eminent observers, two very similar forms called Lockyer Sea and Dawes Sea. Now the Lockyer Sea is perhaps the most definite separate dark spot on the planet. It was observed and figured at Madeira 18 times, but on no occasion could the Dawes Sea be made out. There is a very delicate shade proceeding from a more northern portion of the De la Rue Ocean, somewhat in the position where this sea is figured, and this may have been darker on previous oppositions, or the delicate shading of the original drawings may have been exaggerated either by engraver or printer.

The Lockyer Sea is generally represented as united to the De la Rue Ocean by a narrow inlet, and on one occasion it had

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just this appearance at Madeira; but on the same evening, in steadier air and under a higher power, this appearance was found to be due to the presence of a small lake lying in the line of the supposed connection.

A most careful search was frequently made for the long snakelike form called Bessel Inlet; but, though the examination was continued on a favourable occasion for two hours, it was in vain.

The forms of the markings generally considered to exist both to the west and east of the Kaiser Sea are capable of improvement. They are very delicate, the finest air and considerable magnifying power being required for their observation.

The most earnest attention was given to the delineation of the south pole and its surroundings, in order to make the most of this memorable opposition, and there appears to be very strong evidence of the existence of a sea lying between the southern portion of Hook's Sea and that known as Phillips' Sea, which immediately surrounds the pole.

I cannot conclude this Paper without expressing my thanks to Mr. Marth, who has taken so great an interest in this effort, furnishing me, in the first place, with every information about the island, and afterwards sending me most valuable tables of the revolution of *Mars*, and the dates when certain markings would be on the meridian. I only regret that, in consequence of the close occupation of my time in making the drawings of *Mars*, and the weariness of body produced by work both by day and night, that I was not able to observe the satellites of *Saturn*, as that indefatigable computer would have desired. Still it is hoped that the Madeira observations will not be without result in advancing our knowledge of the most terrestrial of the heavenly bodies.

It is intended to add a critical examination of each of the drawings, together with several matters of interest connected with the observations; but these are more fitted to appear together with the publication of the views of the planet.

Sketches of Mars. By Capt. W. Noble.

The sketches of *Mars*, which I herewith present to the Society, almost explain themselves. They were all made with my (Ross) Equatoreal of 4·2 inches aperture and sixty-one inches focus, and with the same power of 255. I was never able to make out any markings on or near the northern limit of the planet; and, as a rule, all markings shaded off as they approached the preceding and following limbs. It will be noticed, however, that in the greater proportion of cases the markings are sharper and darker towards the following limb than towards the preced-

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ing one, and in the not very frequent instances in which a dark marking is seen to extend actually *to* the limb itself, it is invariably the following one. This would seem to point to the fact that sunrise on *Mars* is much clearer than sunset; but I abstain from any theory as to the cause of this.

Forest Lodge, Maresfield, Uckfield,
November 8, 1877.

On the Motion of the Moon's Node in the case when the Orbits of the Sun and Moon are supposed to have no Eccentricities, and when their mutual Inclination is supposed to be indefinitely small. By Professor J. C. Adams, M.A.

A very able paper has recently been published by Mr. G. W. Hill, assistant in the office of the *American Nautical Almanac*, on the part of the motion of the lunar perigee which is a function of the mean motions of the Sun and Moon.

Assuming that the values of the Moon's coordinates in the case of no eccentricities are already known, the author finds the differential equations which determine the inequalities which involve the first power of the eccentricity of the Moon's orbit, and, by a most ingenious and skilful process, he makes the solution of those differential equations depend on the solution of a single linear differential equation of the second order, which is of a very simple form. This equation is equivalent to an infinite number of algebraical linear equations, and the author, by a most elegant method, shows how to develop the infinite determinant corresponding to these equations in a series of powers and products of the small quantities forming their coefficients. The value of the multiplier of each of such powers and products as are required is obtained in a finite form. By equating this determinant to zero, an equation is obtained which gives directly, and without the need of successive approximations, the motion of the Moon from the perigee during half of a synodic month. The small quantities which enter into the value of the above determinant are of the fourth, eighth, twelfth, &c. orders, considering, as usual, the ratio of the mean motion of the Sun to that of the Moon as a small quantity of the first order; and the author has taken into account all the terms of lower orders than the sixteenth. The ratio of the motion of the perigee to that of the Moon thus obtained is true to twelve or thirteen significant figures. The author compares his numerical result with that deduced from Delaunay's analytical formula, which gives the ratio just mentioned developed in a series of powers of m, the ratio of the mean motions of the Sun and Moon. The numerical